described and explained. The third chapter is occupied with the frequency and pitch of notes, methods of determining the period of a tuning fork, Döppler's principle and musical scales. Whilst comprising little that is new, the account given should prove very useful to students. A short account of resonance and forced vibrations is given in the fourth chapter, whilst the succeeding chapter is occupied with the analysis of vibrations. The mathematical investigation on p. 66, concerning the superposition of harmonic curves, might advantageously have been given rather more in detail considering the class of students for whom the book is written; but there are few other instances where this objection can be raised.

Chapter vi. is concerned with the vibrations of strings, and a very useful and systematic account of this part of the subject is given. This should prove very acceptable to students as leaving unexplained no point on which difficulties are likely to hang. The vibrations of air in pipes, and of rods, plates and membranes, are treated of in an equally satisfactory manner in Chapters vii. and viii.

One of the most interesting chapters in this volume is the ninth, devoted to singing flames, sensitive flames and jets, and musical sand. Lord Rayleigh's investigation of the conditions necessary for the production of a singing flame is clearly and simply explained, and many other phenomena dependent on similar principles are described. The description and explanation of the musical note, produced when certain sands are struck or otherwise disturbed, will doubtless be read with great interest.

Finally, it may be confidently predicted that this volume will meet with an appreciative reception from all serious students of physics. It is characterised throughout by the absence of obscure and inconclusive reasoning such as is sometimes found in treatises dealing with intricate problems in an elementary manner, by the employment of sound yet simple mathematical methods, and by the inclusion of accounts of recent work not to be found in other books of the same class. Many students might wish that examination questions had been added at the end of each chapter, and some may consider that sixty-six pages of advertisements at the end of the book somewhat exceed what might have been expected in this direction. Otherwise it would be difficult to find grounds for any sentiment but gratification that a gap in our scientific literature has been so worthily filled.

E. E.

GEOLOGY AND PRACTICE.

Steinbruchindustrie und Steinbruchgeologie: technische Geologie nebst praktischen Winken für die Verwertung von Gesteinen, unter eingehender Berücksichtigung der Steinindustrie des Königreiches Sachsen. By Dr. O. Herrmann. Pp. xvi + 428. (Berlin: Borntraeger, 1899.)

IN its elaborate title, of which we have omitted the concluding lines, this work explains its own existence. While it gives a useful account of methods of quarrying, and of the practical applications of various kinds of stone, it specially describes the rocks of Saxony and their economic relations at the present day. The two divisions, general and special, occupy almost equal space, and it will be seen that the book is thus a valuable addition to our libraries. What some of the American States have done for their own areas, what Mr. G. H. Kinahan did for Ireland, in his papers on "Economic Geology," is here repeated for a country of great geological interest. It appears that in Saxony, as in London itself, the use of stone for buildings of a permanent character is becoming more and more extensive, while increasing demands are made upon the quarries for ordinary engineering works.

Dr. Herrmann prefaces his book by an account of the more common rock-forming minerals, and of the rocks ordinarily quarried. This is said to be "zur Orientierung für Nicht-Geologen"; but naturally the elements of mineralogical knowledge are presupposed. A quarry-owner would not be expected to identify his minerals from the descriptions given here, but would doubtless have received, in his preliminary scientific training, a good foundation of chemistry and some practical acquaintance with the materials of the earth's crust. Dr. Herrmann therefore does well to emphasise, in his descriptions, the characters that give each mineral or rock its importance from a technical point of view. The lists of localities, reminding one of those in Roth's "Allgemeine Geologie," and references to the buildings where certain rocks have been employed, might, it seems, have been omitted from this section, in view of the forty-three pages devoted to this subject in a later portion of the work.

The author, writing as recently as 1899 (p. 53), places all the ordinary lavas, rhyolite, basalt, and so forth, as "Eruptivgesteine tertiären und nachtertiären Alters," a classification which is merely playing with words, and which has only a superficial justification in the field. His excuse must lie in the powerful continental combination in favour of an arrangement which, to Western minds, savoured too strongly of the Wernerian school; its abandonment of late years may, indeed, mark the breaking down of the "mineral cabinet" system of geology, which the spread of microscopic research tended at one time to maintain.

The valuable section of the work (pp. 123-181) on the characters required in rocks selected for various industrial purposes, and on methods of extraction, is illustrated by photographs of actual quarries, taken by the author. We then pass to the special consideration of the application (Verwertung) of the rocks of Saxony to the technical requirements of the country. Many of these rocks are so well known to every student of geology that an account of their mode of occurrence, from a new point of view, is of scientific as well as industrial importance. We notice the tendency to introduce foreign stones side by side with those of some well-worked local quarry, the materials being cut and polished on the same spot. The natural demand for variety in the colour-scheme of our great city-buildings will often limit the demand for a local stone, however excellent, and "foreign competition" may be favoured by good taste as much as by a war of prices.

The account of the Serpentine of Zöblitz, which "has arisen from the alteration of a Lherzolite," is a good example of the interest attaching to the author's mode of treatment. His historical review extends back to the cutting of the stone by a herd-boy, as he watched his cattle, in the middle of the fifteenth century (p. 255).

As an illustration of the many details of geological

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value that are probably to be found only in these pages, we may mention the statement (p. 235) that the pitchstones of Meissen are melted up, in increasing quantities, for producing bottle-glass, but that difficulties arise from the very ready formation of bubbles in the mass. This at once reminds us of the experiments of Berger, by which obsidians were converted into pumice before the blowpipe, and of Judd's far-reaching deductions in connection with the lavas of Krakatoa.

An appendix gives, in somewhat unnecessary detail, an account of the road-metal used on the Government roads of Saxony in 1896. The conclusion, however (p. 351), is worth quoting: "Thus, from the group of sandstones, limestones, dolomites, mica-schists, phyllites, slates, loams and clays, which together form 40 per cent. of the surface of Saxony, no material at all was selected for the construction of the roads, while only 1·94 per cent. of the total road-length was made of sands and gravels, which none the less cover great areas." This surprising fact may be commended to our county surveyors, especially in the limestone districts of Ireland. It is true that in France, with a magnificent system of steam-rolling and workmen's caravans, a good road can be made of limestone, if frequently examined and renewed; but the failure in such regions as the Côte d'Or plateaux, where the difficulties of our own Cotteswolds are encountered, shows how much lies in the choice of materials at the outset. Perhaps the eye for minerals, and the natural aptitude for their extraction, which have made Saxon miners the pioneers of Europe, have found expression also in the accurate choice of road-metal.

While Dr. Herrmann's work does not presume to rank as a general text-book, it should be added to our scientific and technical libraries, if only as a record of progress in a State where science is rightly regarded as the inspiring muse of industry.

GRENVILLE A. J. COLE.

OUR BOOK SHELF.

Die Mathematik an den Deutschen technischen Hochschulen. Dr. Erwin Papperitz. (Leipzig: Veit, 1899.)

Ueber den Plan eines physikalisch-technischen Instituts an der Universität Göttingen. Felix Klein. (1895.)

Die Anforderungen der Ingenieure und die Ausbildung der mathematischen Lehramtskandidaten. Felix Klein. (1896.)

THESE pamphlets are interesting as showing that the revolutionary ideas brought forward by Prof. Perry on the teaching of mathematics have already begun to agitate the German academic mind; and that his ideas concerning the proper method of presenting the principles of the subject, having regard to the requirements of the student, will receive powerful support in Germany.

The cleavage now going on in mathematical thought was very evident in the recent Physical and Mathematical Congresses, held simultaneously in Paris. The followers of Maxwell and Kelvin found the interest they required in the Physical Congress; the Mathematical Congress was almost entirely engrossed in the development of the analytical ideas of Weirstrass. A lover of music nowadays must become a Wagnerian, or run the risk of hearing no music at all; so, too, the mathematician, who is not absorbed in developments of the convergency of series, must turn to the physical section for the interest he requires.

The Cambridge student of old-fashioned mathematical physics, of the school which the foreigner considered worth imitation, is now driven elsewhere, into the National Science Tripos; and so we find the serious shrinkage in the Mathematical Tripos now in rapid progress.

G.

A Glossary of Botanic Terms with their Derivation and Accent. By Benjamin Daydon Jackson. Pp. xi + 327. (London: Duckworth and Co., 1900.)

MR. DAYDON JACKSON has laid those who have to consult botanical literature under a great obligation by the publication of this excellent and compendious glossary. Such a work was badly needed, and no one possesses greater qualifications for the undertaking of it than Mr. Jackson himself, who has done such good work in other departments of an analogous character.

The definitions are usually good and concise, and the errors, so far as we have been able to discover them, are surprisingly few. We cannot help, however, expressing our regret that in the definition of the words "axial" and "axile" the author did not emphasise the difference between them which has been insisted on by some of the best writers. *Axial* should be reserved for structures appertaining to the morphological axis (as distinct from its appendages), *axile* merely denoting position without reference to the morphological nature of the structure concerned. But it would be unfair to tax Mr. Jackson with a confusion only too apparent in literature in which the two terms are frequently used synonymously.

It is often of interest to know by whom a term was introduced, as it is thus possible to ascertain exactly the meaning it was originally intended to convey, and it is to be hoped that Mr. Jackson may see his way to give this information in a future edition. Some of the more recently introduced terms are already dealt with in this way in the volume before us, and we cannot but think that an extension in the direction indicated would still further improve what is already an exceedingly valuable work of reference.

Antropometria. By Dr. R. Livi. Pp. 237. (Milan: Hoepli, 1900.)

THE "Antropometria" of Dr. Livi treats of the subject under three main headings. In Part i. measurements are enumerated and described and their modifying factors reviewed. Instruction is then given in the treatment of data, with especial reference to the statistical method. Part ii. will be found to contain generalisations based on the foregoing sources of evidence, and expressed in the form of laws regulating the rate of growth in various parts of the body; some useful notes on the relation of stature and weight are appended to this part. Part iii. is devoted to an exposition of the principles and method of anthropometric identification, and a stenographic system of recording observations, similar to that used by Dr. Garson in this country, is suggested. Finally, a long table of indices will be found at the end of the volume. Like Dr. Livi's other work, the present contribution to anthropometric literature is thorough and clear; the manual will be extremely useful to students and teachers of physical anthropology.

Elementary Questions in Electricity and Magnetism. Compiled by Magnus Maclean, D.Sc., and E. W. Marchant, D.Sc. Pp. viii + 59. (London: Longmans, Green and Co.)

IT is sometimes a convenience to teachers and students to possess a collection of questions apart from those often given in text-books. There are 311 questions in this volume, arranged under 24 different headings, referring to various sections of frictional electricity, magnetism and current electricity. In addition, the book contains 14 tables of electrical constants, and answers to the numerical questions. The student who works through the exercises in the book will establish his knowledge of electrical principles upon a sound footing.

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